ENVIRONMENTAL Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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Trichloroethylene: Health Information Summary

Trichloroethylene (TCE) is a synthetic liquid chemical with a sweet odor. It was once used as a general anesthetic. Its current main use is as a solvent and degreaser for metal compounds in the metal parts manufacturing, electronics and automotive industries. It is also found in many consumer products including paints, paint strippers, adhesives, varnishes and spot removers. TCE may be buried in landfills or dumped into the ground or sewers when mixed with grease or oil where it readily migrates to groundwater. TCE is the most common organic contaminant detected in U.S. groundwater. Although TCE in surface soil or surface water readily volatilizes into the air as a gas, it generally remains stable in groundwater for months to years. Under low oxygen conditions in groundwater, TCE eventually degrades to other toxic chlorinated chemicals such as 1,1-dichloroethene and vinyl chloride. The odor threshold for TCE in air is reported as 100 parts per million (ppm); there is no information on its odor threshold in water.

Health Effects

Absorption

Studies indicate that 40 to 70 percent of TCE is absorbed by inhalation exposure. In an oral exposure study with rats, absorption of about 90 percent was observed. Dermal absorption is also known to occur, but the fraction absorbed has not been measured. The body eliminates most absorbed TCE within two days. The small amount remaining may be released slowly from fat cells over several days to a few weeks.

Short-Term (Acute) Effects

Inhalation and ingestion exposures to high levels of TCE such as with poisonings and its former use as an anesthetic have resulted in disturbances of heart rhythm. This observation is supported by results in some animal studies. High TCE exposure levels by inhalation that occurred in industrial accidents caused central nervous system symptoms such as headache, sleepiness, dizziness, blurred vision and loss of facial sensation. High acute exposures have resulted in nerve damage, causing facial numbness and jaw weakness that lasted several months.

Long-Term (Chronic) Effects

Chronic inhalation exposure to low levels of TCE in occupational settings has produced central nervous system effects including memory loss, mood swings, and facial nerve damage. Another study of long-term exposure reported such effects as eye irritation, cough, drowsiness, weakness, dizzines and heart palpitations.

Abnormalities of the immune system were detected in a study of humans exposed to TCE-contaminated drinking water. Investigators who conducted an animal study concluded that the immune system was sensitive to TCE.

Studies of humans exposed to high levels of TCE in an occupational setting indicate that this chemical can induce damage to the liver and kidney. Animal studies support the human evidence that both liver and kidney damage can result from TCE exposure.

Carcinogenic (cancer-causing) Effects
A large study of cancer registry data from New Jersey found associations between exposure to TCE in drinking water and elevated rates of leukemia and lymphoma. Another study with exposure from drinking water found an elevated risk of leukemia for those exposed in utero. Several human studies have detected an association between kidney cancer and TCE exposure.

Oral TCE exposure in animal studies has caused increased tumors in the liver and kidneys while inhalation exposure resulted in increased liver and lung tumors. TCE fits into the old EPA cancer categorization scheme as a Group B, "probable human carcinogen" while federal government agencies have described TCE as a "highly likely human carcinogen" based on the new EPA cancer guidelines.

Reproductive/Developmental Effects
Some studies of humans exposed to TCE in drinking water reported increases in developmental effects involving the nervous system, heart, and hearing. These are tentative findings and cannot as yet be definitely associated with TCE exposure. Some animal studies supported the effects seen in humans, with TCE exposure causing developmental effects, especially those associated with the heart. Other animal studies indicate that TCE can affect the ability of males and females to reproduce and can also decrease fetal growth.

Health Standards and Criteria

The EPA has established a Maximum Contaminant Level Goal (MCLG) of zero parts per billion (ppb = micrograms per liter or ug/l) for TCE in public drinking water systems. MCLGs are health-based non-enforceable guidelines and have traditionally been set at zero for "known" and "probable" human carcinogens. The EPA has also established a Maximum Contaminant Level (MCL) for TCE. MCLs are enforceable drinking water standards determined by balancing the adverse health effects of a particular chemical against the feasibility and costs of treating contaminated water. The MCL for TCE is 5 ppb.

Because TCE is considered a probable human carcinogen, there may be some degree of carcinogenic risk even below the MCL. The EHP estimates that drinking water containing 5 ppb TCE would be associated with an increased lifetime risk of cancer in the range of between three and 60 in one million (three to 60 excess cancer cases in 1,000,000 people exposed). This estimate is based on a daily intake of two liters of water per day for 70 years. Those at the upper end of the cancer risk range may include children, individuals with high alcohol consumption, or those who are also exposed to other chlorinated solvents that have similar breakdown products in the body. Most evidence indicates that the breakdown products of TCE are largely responsible for its toxicity, including its potential to cause cancer. There is also recent information suggesting that individuals with diabetes may be more susceptible to TCE's effects.

The Occupational Safety and Health Administration (OSHA) enforceable standard for TCE in workplace air, a permissible exposure limit or PEL, is 100 ppm averaged over an eight hour workday.

For more information, please contact the DES Environmental Health Program, 29 Hazen Drive, Concord, NH 03302-0095; (603) 271-4608.

Suggested Reading and References

Casarett and Doull's Toxicology: The Basic Science of Poisons, Fifth Edition. Klaassen, C.D., ed. McGraw-Hill Publishing Co., Inc., New York, 1995.

Assessing the Human Health Risks of Trichloroethylene: Key Scientific Issues. National Research Council, Board on Environmental Studies and Toxicology. Prepublication copy available at: http://newton.nap.edu/catalog/11707.html. 2006.

Case Studies in Environmental Medicine: Trichloroethylene (TCE) Toxicity. Agency for Toxic Substances and Disease Registry (ATSDR). Atlanta, GA. January, 2001.

Toxicological Profile for Trichloroethylene (Update). Agency for Toxic Substances and Disease Registry (ATSDR). Atlanta, GA. September, 1997.